

Global Tropospheric Experiment Arctic Boundary Layer Expedition 3B (ABLE 3B) Langley ASDC Data Set Document



Summary

This document provides information on data products obtained during the GTE ABLE 3B atmospheric science expedition conducted over northeastern Canada during July and August, 1990. The objective of the mission was to assess the importance of the Hudson Bay lowlands as a source of global methane. Measurements were made primarily by investigators' instruments located on the NASA WFF Electra airplane. Also provided are a list of principal investigators and a list of publications.

This document provides information for the following three data sets:

- GTE_A3B_Elec_Chem
- GTE_A3B_Elec_Flux [TAMMS aircraft data]
- GTE_A3B_Tower

Acknowledgment

NASA funded the investigators involved in the ABLE 3B mission. The funded investigators, their organization and grant, agreement or contract number were:

Area	Investigator	Organization	Grant
Aircraft	John Barrick	NASA Langley	N/A
	John Bradshaw	Georgia Tech	N/A
	Edward Browell	NASA Langley	N/A
	Gerald Gregory	NASA Langley	N/A
	John Ritter	NASA Langley	N/A
	Sherwood Rowland	U of California-Irvine	N/A
	Glen Sachse	NASA Langley	N/A
	Hanwant Singh	NASA Ames	N/A
	Robert Talbot	U of New Hampshire	N/A
Surface	David Fitzjarrald	State U of New York-Albany	N/A
	Robert Talbot	U of New Hampshire	N/A
	Steven Wofsy	Harvard	N/A
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1. Collection Overview

a. Collection Contents

Aircraft data sets are available for each investigation for each flight. Ground-based data are usually available on a daily basis. Airborne measurements were typically obtained at constant altitude over northern Canada during transit flights (i.e. "survey" flights), and over multiple altitudes during flights closer to the intensive sites. Flight missions were conducted during ABLE 3B from July 6 through August 15 1990. Section 4.b lists the flight. The duration, altitude range, ascent and descent rate, and flight path for each mission varied depending on mission objectives and environmental (weather) conditions. Ground-based measurements are discussed in Harriss et al., [1994]. The automated ground sites provided daily measurements during the time frame when airborne measurements were being made and weekly averaged samples before and after. Further information about the measurement region and time frame may be found in the Journal of Geophysical Research, Vol. 99, No. D1, 1635-1643, January 20, 1994.

Data Set Introduction

This data set contains all of the WFF Electra aircraft data and ground data collected from a tower in Schefferville, Ontario submitted to the GTE data archive by the ABLE 3B investigators listed in Section 1.d. Included are the atmospheric chemistry, meteorological and navigational data recorded aboard the NASA Wallops Electra airborne laboratory and data obtained from a surface level site in Schefferville, Ontario. Isentropic back trajectories and merged data sets are not included in this archive. Those data can be found at the [GTE data archive](#).

Summary of Parameters

The atmospheric species and other parameters measured are listed in Section 4.c. Also listed for each are the name and affiliation of the principal investigator.

b. Related Data Collections

ABLE 3B investigators have individually reported the results of their investigations in the Journal of Geophysical Research, Vol. 99, No. D1, January 20, 1994.

There are data sets available from the Langley ASDC for 13 other GTE missions conducted from 1983 to 2001. See the [GTE home page](#) and/or the [ASDC GTE Data and Information page](#) for a description of the available data.

c. Title of Investigation

Global Tropospheric Experiment Arctic Boundary Layer Expedition 3B (ABLE 3B)

d. Investigator Name and Title

If the person is known to be retired, deceased or no longer at the organization responsible for the investigation, it is noted and the contact information may be omitted. The contact information provided was current during the mission, but may no longer be current.

Electra Measurements Investigators

Investigator Area	Investigator Information
Airborne Meteorological/Position Data	John D. Barrick MS 483 NASA Langley Research Center Hampton VA 23681-0001 Telephone: 757-864-5831 Fax: 757-864-5841 E-mail: john.d.barrick@nasa.gov
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e. Technical Contact(s)

The following persons have more specialized knowledge about the data in the data sets or in their field or general knowledge about the mission, its execution and the data sets.

Investigator or Knowledge Area	Investigator and Contact Information	
Non-methane hydrocarbon measurements aboard the Electra	Donald Blake University of California-Irvine Department of Chemistry Irvine CA 92717 Telephone: 714-856-4195 Fax: 714-725-2905 E-mail: drblake@uci.edu	
ABLE 3B Mission Scientist and Associate Mission Scientist	R. C. Harriss Institute for the Study of Earth, Oceans and Space Science and Engineering Research Center University of New Hampshire 929 College Road Durham NH Telephone: 603-862-3875	S. C. Wofsy (See prior listing above)
ABLE 3B Program Manager	Robert J. McNeal (retired) NASA Headquarters	
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ABLE 3B Mission Meteorologist	Mark Shipham (no longer at NASA) NASA Langley Research Center	
ABLE 3B Expedition Manager	Richard J. Bendura (retired) NASA Langley Research Center	
Electra Aircraft Operations and Systems Integration	Roger Navarro (retired) NASA Wallops Flight Facility	Wallops Flight Facility Aircraft Office NASA Wallops Flight Facility Wallops Island VA 23337-5099 Telephone: 757-824-1529
Project Coordinator	Helen Ann Thompson (no longer at ST Systems)	
ABLE 3B Data Manager	Joseph W. Drewry (retired) NASA Langley Research Center	

2. APPLICATIONS AND DERIVATION

Potential usage and applications of the described data sets can be seen in the articles that comprise the Journal of Geophysical Research ABLE 3B Special Section (Vol.99, No. D1 January 20, 1994), the 1991 Spring AGU Meeting.

a. Calculated Variables

For convenience of the users, the calculated variables below are provided.



Mach Number, M:

$$M = \sqrt{5 * \left[\left(\frac{Q_c}{P_s} + 1 \right)^{\frac{2}{\gamma}} - 1 \right]}$$

M = Mach Number
 P_s = Static Pressure
 Q_c = Differential Pressure

Static Air Temperature, T_s:

$$T_s (^{\circ}\text{K}) = \frac{T_T}{\left[1 + M^2 * \left(\frac{\gamma - 1}{2} \right) \right]}$$

T_s = Static Air Temperature (°K)
 T_T = Total Air Temperature (°K)
 γ = 1.4, ratio of specific heat of air at constant pressure and volume

True Air Speed, TAS:

$$\text{TAS(kts)} = M * a = M * 38.96695 * \sqrt{T_s}$$

TAS = True Air Speed (knots)
 T_s = Static Air Temperature (°K)
 M = Mach Number
 a = Speed of Sound

Potential Temperature, θ:

$$\theta (^{\circ}\text{K}) = T_s * \left(\frac{1000}{P_s} \right)^{0.2857142}$$

θ = Potential Temperature (°K)
 T_s = Static Air Temperature (°K)
 P_s = Static Pressure (mb)

Vapor Pressure, e :

$$e_{\text{water}} (\text{mb}) = [1.0007 + (3.46 * 10^{-6} * P_s)] * 6.1121 * \text{EXP}[17.502 * T / (240.97 + T)]$$

$$e_{\text{ice}} (\text{mb}) = [1.0003 + (4.18 * 10^{-6} * P_s)] * 6.1115 * \text{EXP}[22.452 * T / (272.55 + T)]$$

e = Partial Pressure of Water Vapor (mb)
 P_s = Static Pressure (mb)
 T = Static Air Temperature (°C) for Saturation Vapor Pressure
 or
 T = Dew/Frost Point (°C) for Partial Pressure of Water Vapor

Note:

1. ProjDP of zero or greater should be used to derive the partial pressure of water vapor w.r.t water (e_{water}) and the ProjDP less than zero should be used to derive the partial pressure of water vapor w.r.t ice (e_{ice}).
2. StatTempDegC and ProjDP parameters recorded in the P-3B data set are substituted to calculate saturation vapor pressure and partial pressure of water vapor, respectively.
3. TSDEGC and ProjDP parameters recorded in the DC-8 data set are substituted to calculate saturation vapor pressure and partial pressure of water vapor, respectively. Also notice in the DC-8 data set there is a redundant static air temperature measurement, TSCALC, which is calculated by DADS. Although TSDEGC and TSCALC track closely they can diverge by ? 1° at the low and high ends of the measurement range.

Specific Humidity, q:

$$q(\text{g/kg}) = \frac{0.622 * 10^3 * e}{(P_s - 0.377e)}$$

$$q(\text{ppmw}) = \frac{0.622 * 10^6 * e}{(P_s - 0.377e)}$$

Mixing Ratio, r:

$$r(\text{g/kg}) = \frac{0.622 * 10^3 * e}{(P_s - e)}$$

$$r(\text{ppmw}) = \frac{0.622 * 10^6 * e}{(P_s - e)}$$

Note:

ppmv = 1.608 * ppmw
 ppmw = 0.622 * ppmv



Relative Humidity, %:

w.r.t. water,

$$RH_{\text{water}} = \frac{e_{\text{water}}}{e_{s_{\text{water}}}} * 100$$

w.r.t. ice,

$$RH_{\text{ice}} = \frac{e_{\text{ice}}}{e_{s_{\text{ice}}}} * 100$$

b. Graphs and Plots:

Interested readers should see the Journal of Geophysical Research, Vol. 99, No. D1, January 20, 1994, and documents referenced therein, for plots and the results of analysis of data.

3. DATA DESCRIPTION AND ACCESS

a. Format

See the [GTE Data Format Document](#).

b. Data Organization

Granularity

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary. Aircraft data sets are available for each investigation for each flight. Surface level data are available on a daily basis.

c. Data Collection Status and Plans

All of the WFF Electra aircraft and ground (tower) data for the ABLE 3 mission is contained in the archive. No additional data products relevant to ABLE 3 are anticipated. Isentropic back trajectories and merged data sets are not included in this archive. Those data can be found at the [GTE data archive](#).

d. Data Access

This data is available online through the [GTE Data and Information table](#) or on a [CDROM via the LaRC ASDC](#) and from the [GTE data archive](#).

e. Data Archive Center

The Atmospheric Science Data Center at NASA's Langley Research Center.

Contacts for Data Center or Data Access Information:

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f. How to Cite the Data Collection

Publication of a portion(s) of the data archive should acknowledge the principal investigator(s) responsible for the data by referencing the appropriate manuscript in the Journal of Geophysical Research, Vol. 99, No. D1, January 20, 1994.



4. DATA CHARACTERISTICS:

a. Study Area

Airborne measurements were made over northern Canada. A more detailed description of the surface level environmental characteristics for the experiment region is provided in the individual papers for each investigation included in the Journal of Geophysical Research, Vol. 99, No. D1, January 20, 1994. Additional information may be found in other publications authored by the principal investigators or on the [GTE home page](#).

Spatial Coverage

Fight missions were conducted during July and August 1990. The duration, altitude range, ascent and descent rate, and flight path of each mission varied depending on mission objective and environmental conditions. The nominal air speed ranged from 239 knots (approximately 275 mph) at 5.5 km altitude to 196 knots (approximately 226 mph) at 0.13 km.

Data Set Name	Min Lat	Max Lat	Min Lon	Max Lon
GTE_A3B_Elec_Chem	37.05N	63.75N	106.17W	49.40W
GTE_A3B_Elec_Flux	45.99N	58.78N	94.58W	60.21W
GTE_A3B_Tower*	55.00N	55.00N	67.00W	67.00W

Spatial and Temporal Resolution

Resolution varies for each measurement. See the individual headers associated with each data file for specific information.

Grid Description

No data gridding or binning of data to a geographic grid occurred during data processing.

b. Temporal Coverage

Twenty-two aircraft missions were conducted from July 6 to August 15, 1990. Harris et al., [1994] shows dates and times for each mission. Ground site measurements at the Schefferville tower station were obtained from June 11 to August 17, 1990.

Data Set Name	Begin Date	End Date
GTE_A3B_Elec_Chem	7/6/90	8/15/90
GTE_A3B_Elec_Flux	7/11/90	8/11/90
GTE_A3B_Tower	6/11/90	8/17/90

c. Parameter or Variable

Not all of the parameters are in each data set granule. Also, the ranges vary between data sets and between granules within each data set. Species measured are given in Harris et al., [1994].

Parameter Description

The variables measured are standard atmospheric chemical and meteorological species requiring no further elaboration here.

Unit of Measurement

The units of measure vary widely depending on species and measurement environment and are addressed in the individual papers for each investigation included in the Journal of Geophysical Research, Vol. 99, No. D1, January 20, 1994.

Parameter Source

The instruments used in making the measurements are listed in the individual papers included in the ABLE 3B Special Section in the Journal of Geophysical Research, Vol. 99, No. D1, January 20, 1994.

Parameter Range

The ranges of data vary widely depending on species and measurement environment and are addressed in the individual papers for



each investigation included in the Journal of Geophysical Research, Vol. 99, No. D1, January 20, 1994.

Sample Data Record

The [GTE Data Format Document](#) contains examples of each data set type.

d. Error Sources

The sources of error vary depending on species and measurement environment and are addressed in the papers included in the ABLE 3B special issue of the Journal of Geophysical Research, Vol. 99, No. D1, January 20, 1994, and/or papers referenced in that publication and readme files and/or header records associated with each data file.

5. USAGE GUIDANCE

a. Known Problems with the Data

None reported for the current archive version. See the readme files and header records included with each data set for information provided by the responsible investigator.

b. Future Modifications and Plans

The data sets submitted to the ASDC are considered final and no further updates are planned. However, modifications will be considered if requested by the investigators or otherwise justified.

6. ACQUISITION MATERIALS AND METHODS

Details of data acquisition and materials are addressed in the Journal of Geophysical Research ABLE 3B Special Section (Vol.99, No. D1 January 20, 1994), and the 1991 AGU Spring Meeting.

7. REFERENCES

AGU Spring Meeting, Baltimore, MD, 28-31 May 1991.

ABLE 3B Special Section, Journal of Geophysical Research, Vol.99, No. D1 January 20, 1994.

[GTE Bibliography](#)

Harriss, R. C., S. C. Wofsy, J. M. Hoell, , R. J. Bendura, J. W. Drewry, R. J. McNeal, D. Pierce, V. Rabine, and R. L. Snell, The Arctic Boundary Layer Expedition (ABLE 3B): July-August 1990, J. Geophys. Res., Vol. 99, No. D1, 1635-1643, 20 January, 1994.

8. ACRONYMS

ABLE 3A - Arctic Boundary Layer Expedition
AGU - American Geophysical Union
ASDC - Atmospheric Science Data Center
BREW - Biospheric Research of emissions from Wetlands
CIRAC - Canadian Institute for Research in Atmospheric Chemistry
CNWP - Canadian Northern Wetlands Project
DADS - Data Acquisition and Display System
EOSDIS - Earth Observing System Distributed Information System
GTE - Global Tropospheric Experiment
IMS - Information Management System
NASA - National Aeronautics and Space Administration
NOWES - Canadian Northern Wetlands Study
ProjDP - Project Dew Point
TSCALC - Static temperature, calculated by DADS
TSDEGC - Static temperature, measured directly, in Celsius

9. Document Information:



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- **Identification:**
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